Cooperative Engagement Capability Sensor Adaptation for Sensor Netting

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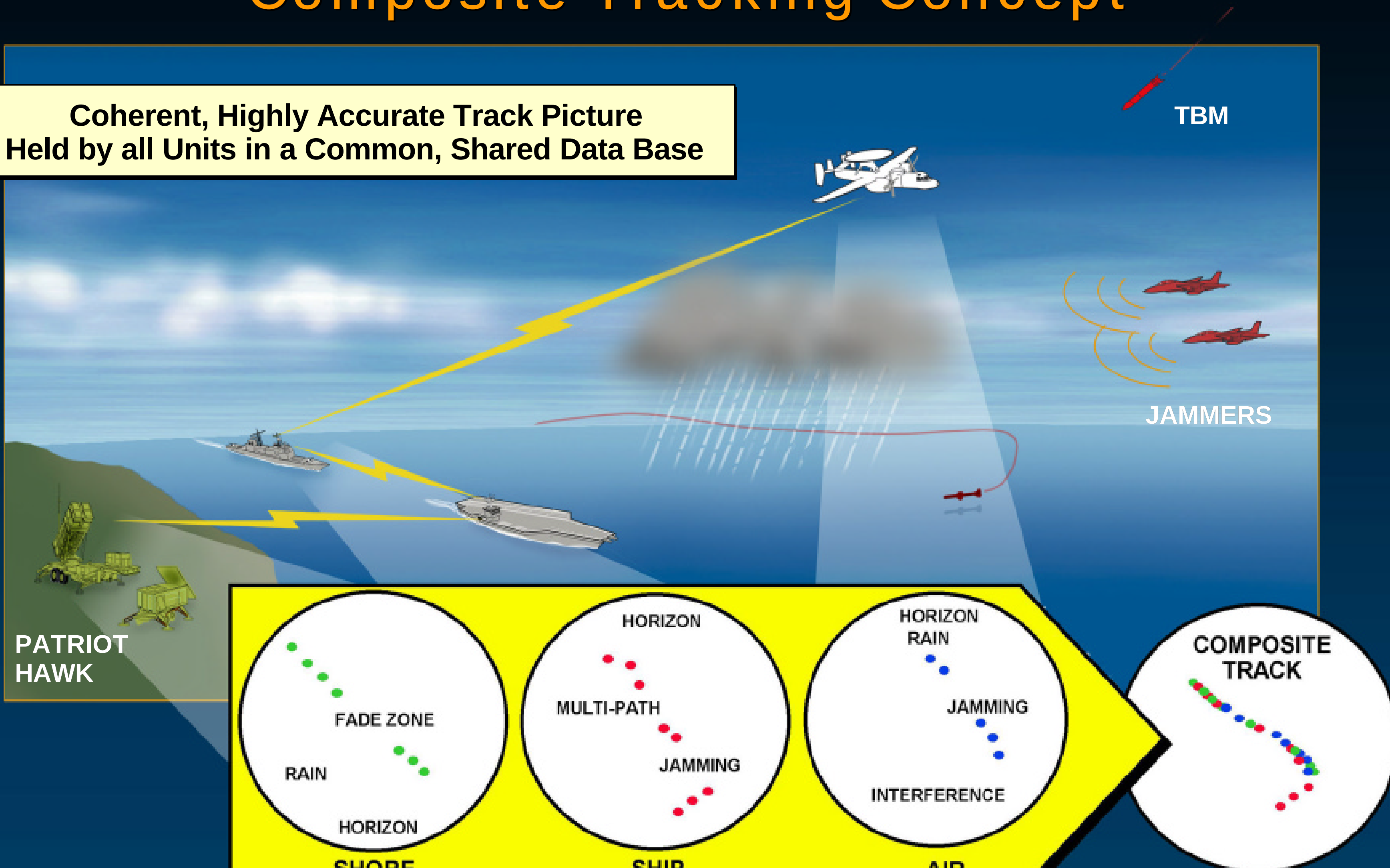
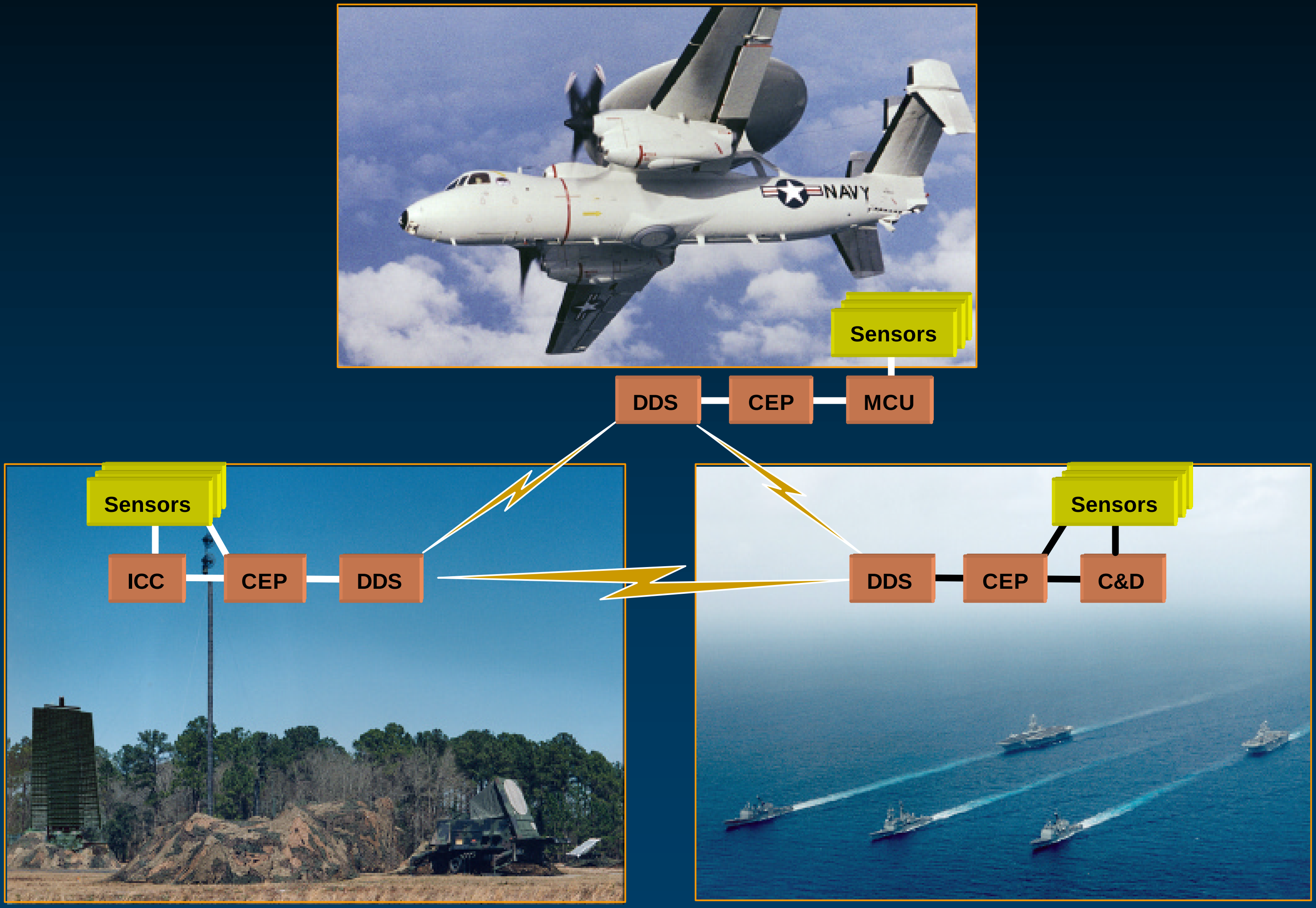
Sensor Netting
Composite Tracking Concept

Coherent, Highly Accurate Track Picture
Held by all Units in a Common, Shared Data Base

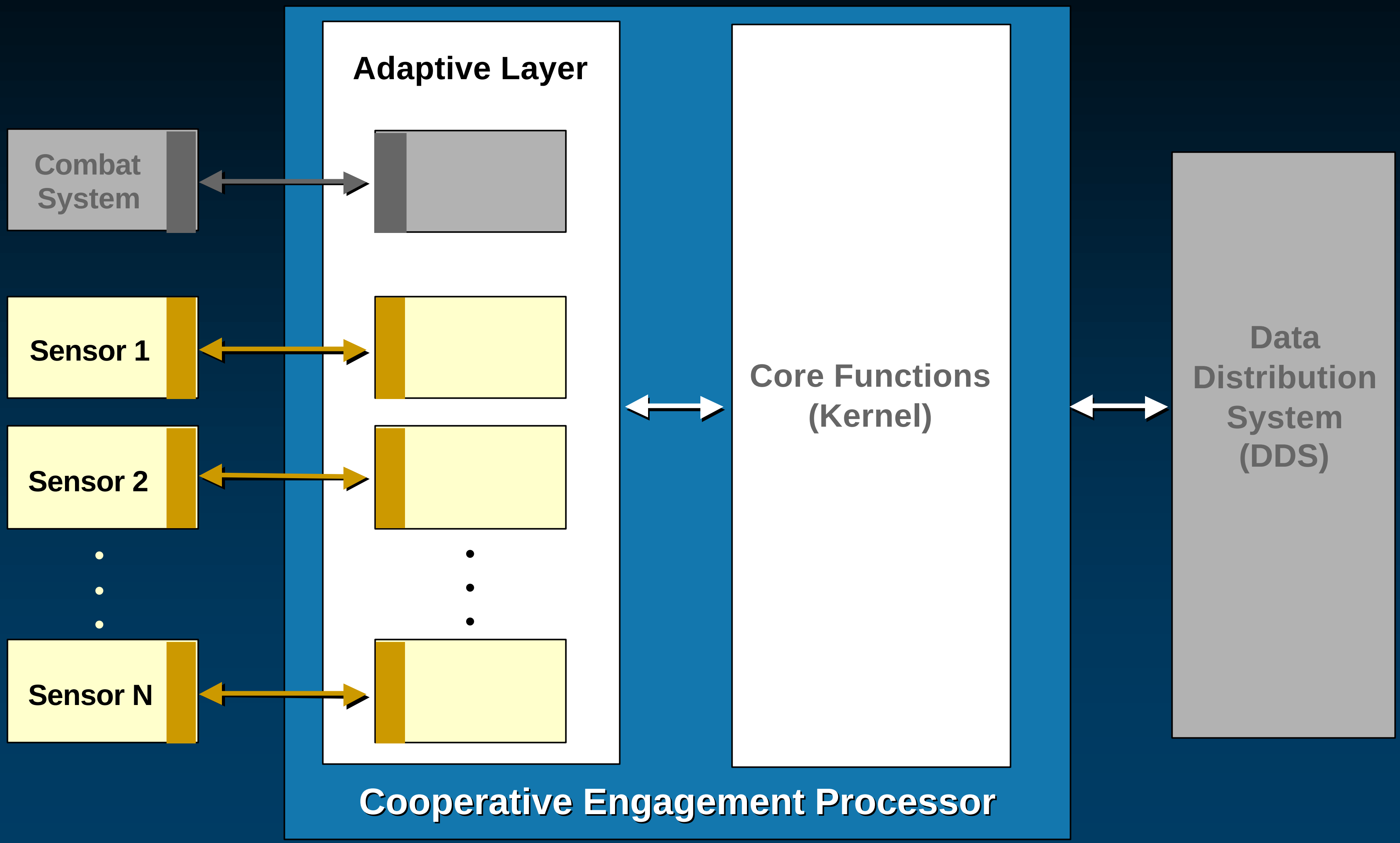


CEC Nets Sensors, Exchanges Sensor Measurements Between all Netted Sensors, and Fuses Data to Create a Composite Track

Cooperative Engagement Capability



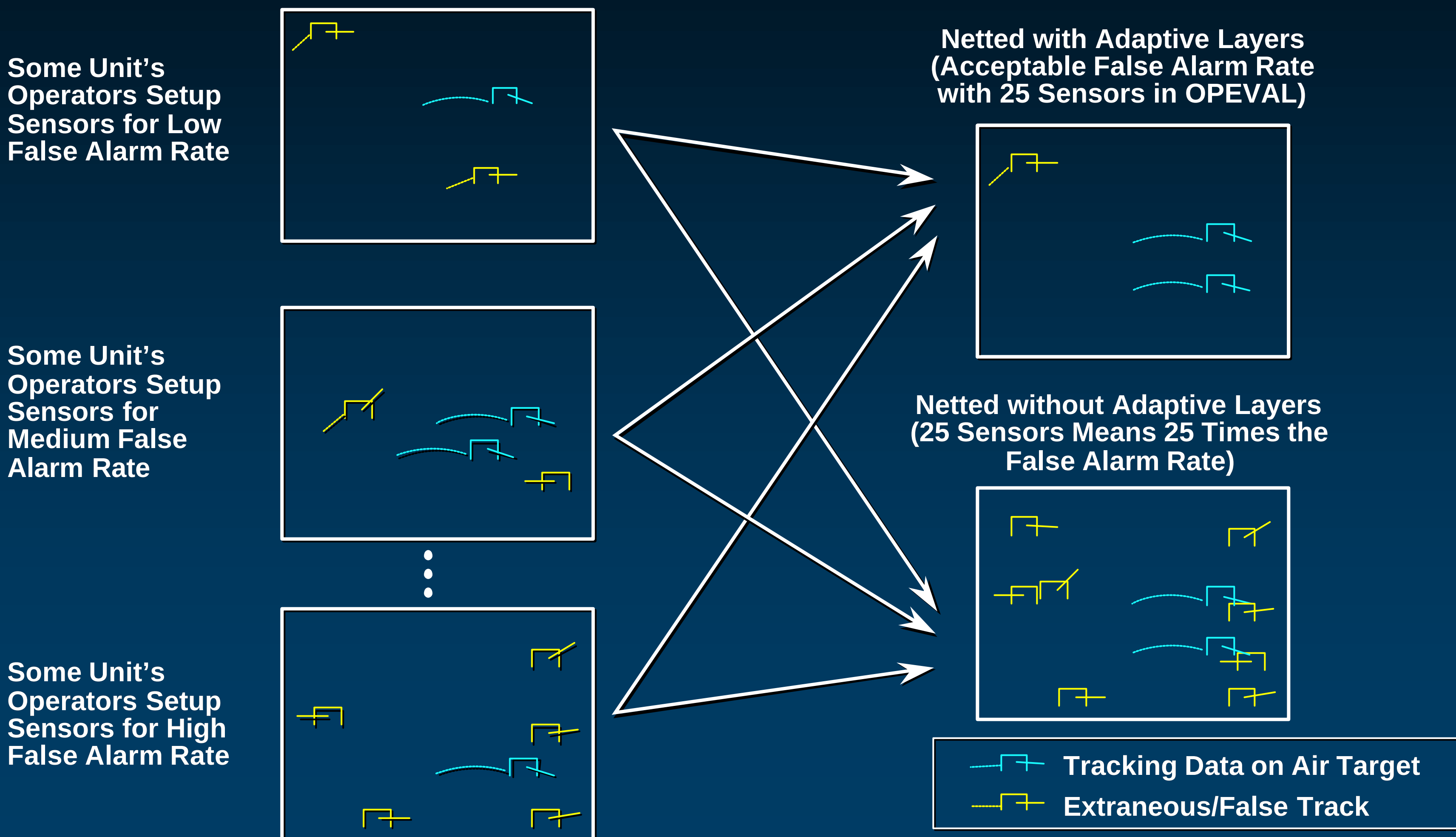
System Design



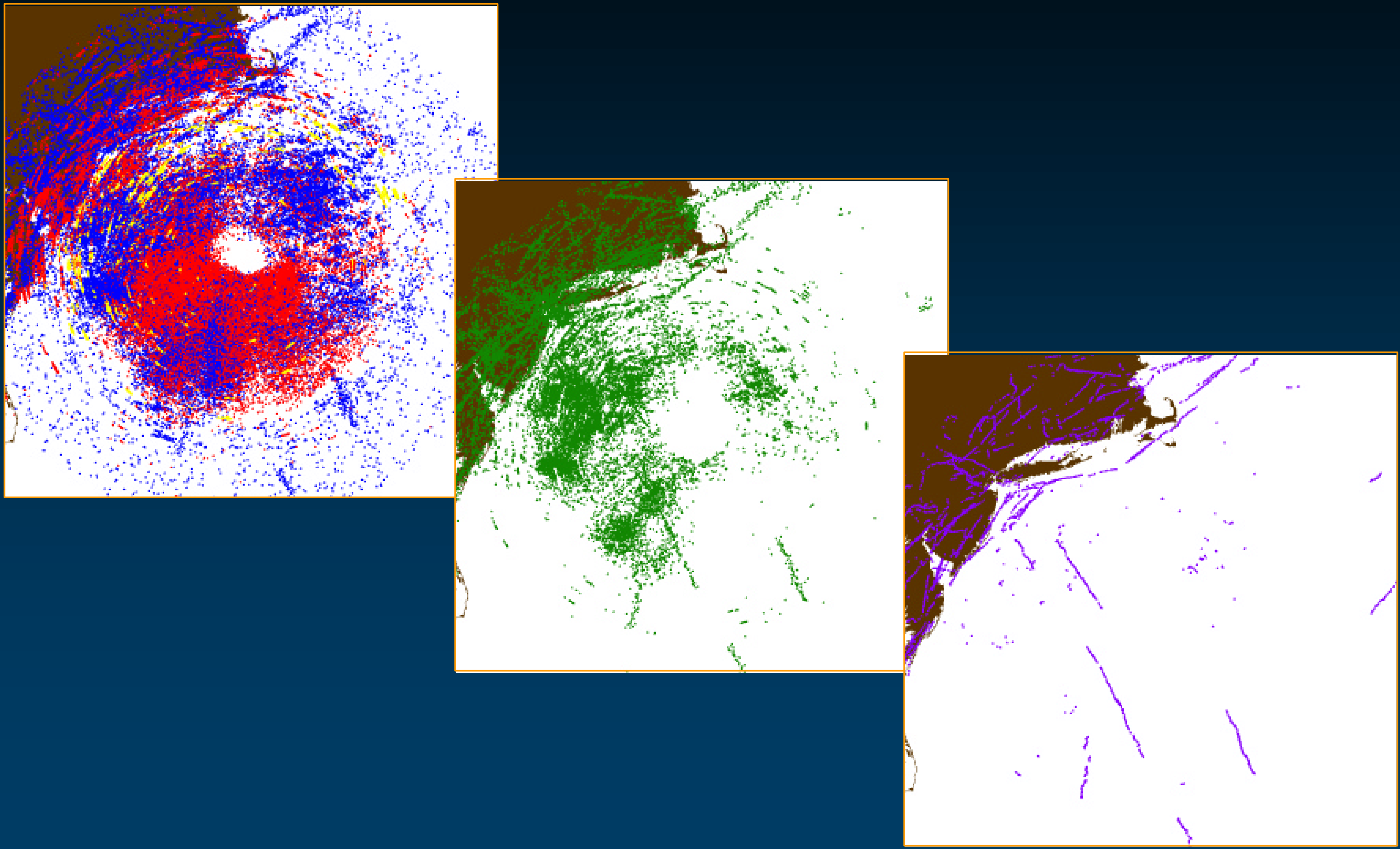
Why Adaptive Layers?

- To control false detection rate when many sensors combined (25 sensors in OPEVAL)
- To associate sensor data to composite track
- To accommodate many different interface standards
- To put the data in a common format
  - Adaptive Layer permits CEC to interface with dissimilar systems while maintaining a common set of code (Kernel Functions)
- To limit cost of modifying existing systems
  - Accommodates sensor-specific and command/weapon-specific characteristics and performance
    - false alarm and false track rate
    - available types of information
    - track reporting rates
    - system time reference

Adaptive Layers Regulate False Data Rate into the Network Ensuring an Uncluttered Picture



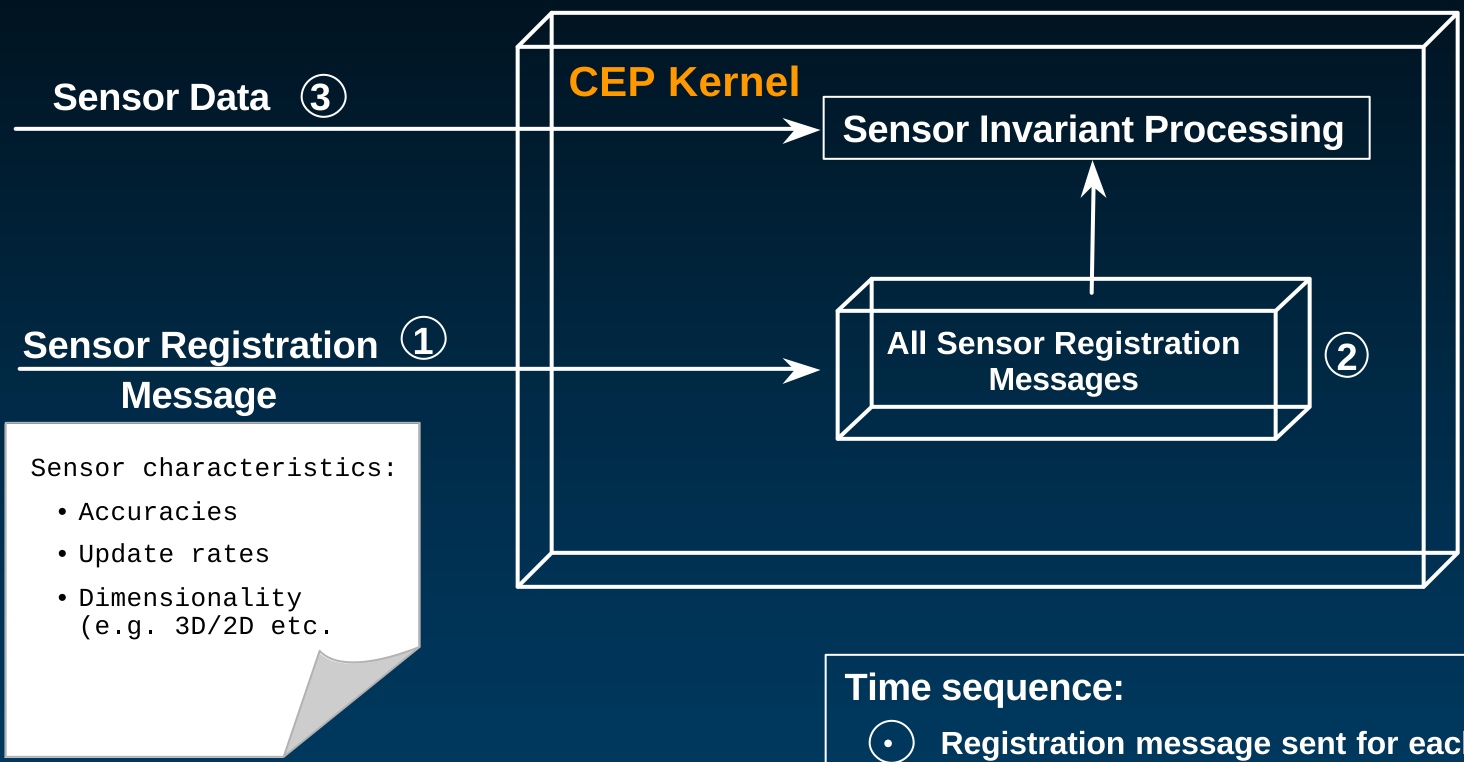
False Alarm Control Example



Evolution of CEP Core and Adaptive Layer

- During the Development Stages of CEC, the requirements and design of the Adaptive Layer were developed individually for each sensor
  - Required modifications to core functions
- Process evolution includes
  - Sensor invariant Core Functions
  - Common Integration standards for Sensors
    - Message Definition standards for Sensor/CEP Interface
    - Adaptive Layer Functional and Performance Requirements
  - Re-allocation of Adaptive Layer and Core functions
    - Reduction of Adaptive Layer functionality
  - Information Package
    - CEC Sensor Integration Background
    - CEC Information
    - Sensor Information Request

CEP Sensor Invariance



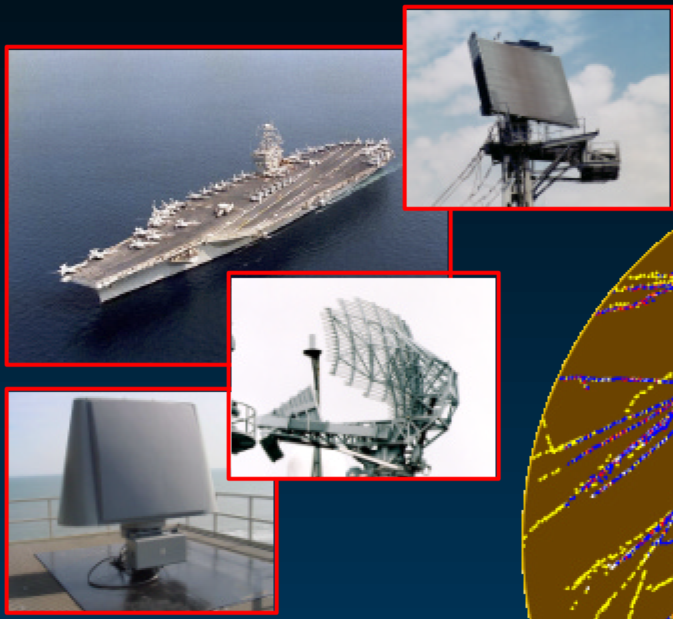
CEP Kernel processing is sensor invariant:

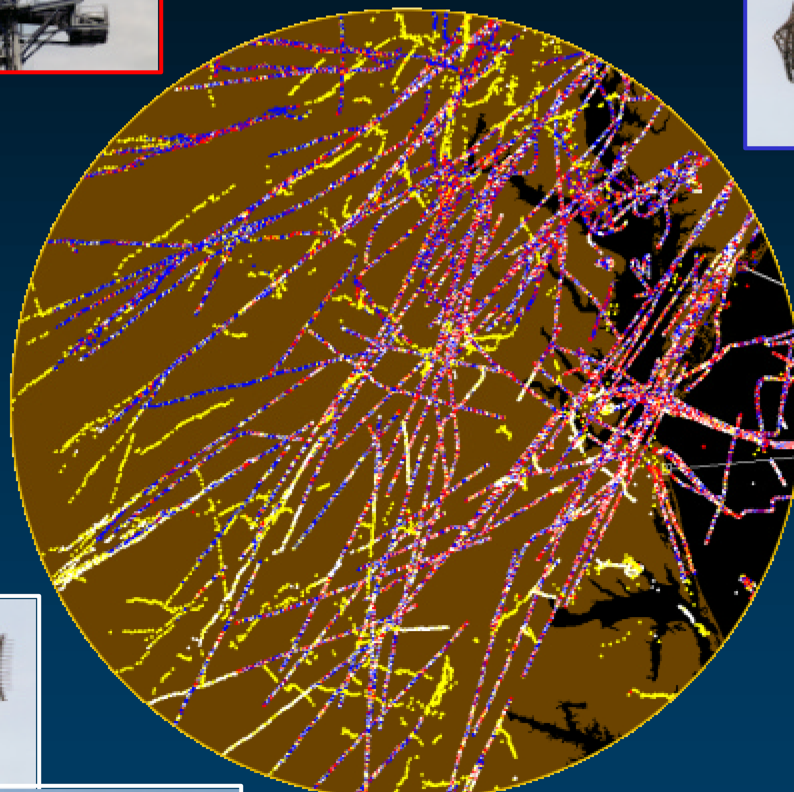
Does not require change as new sensors added

Time sequence:

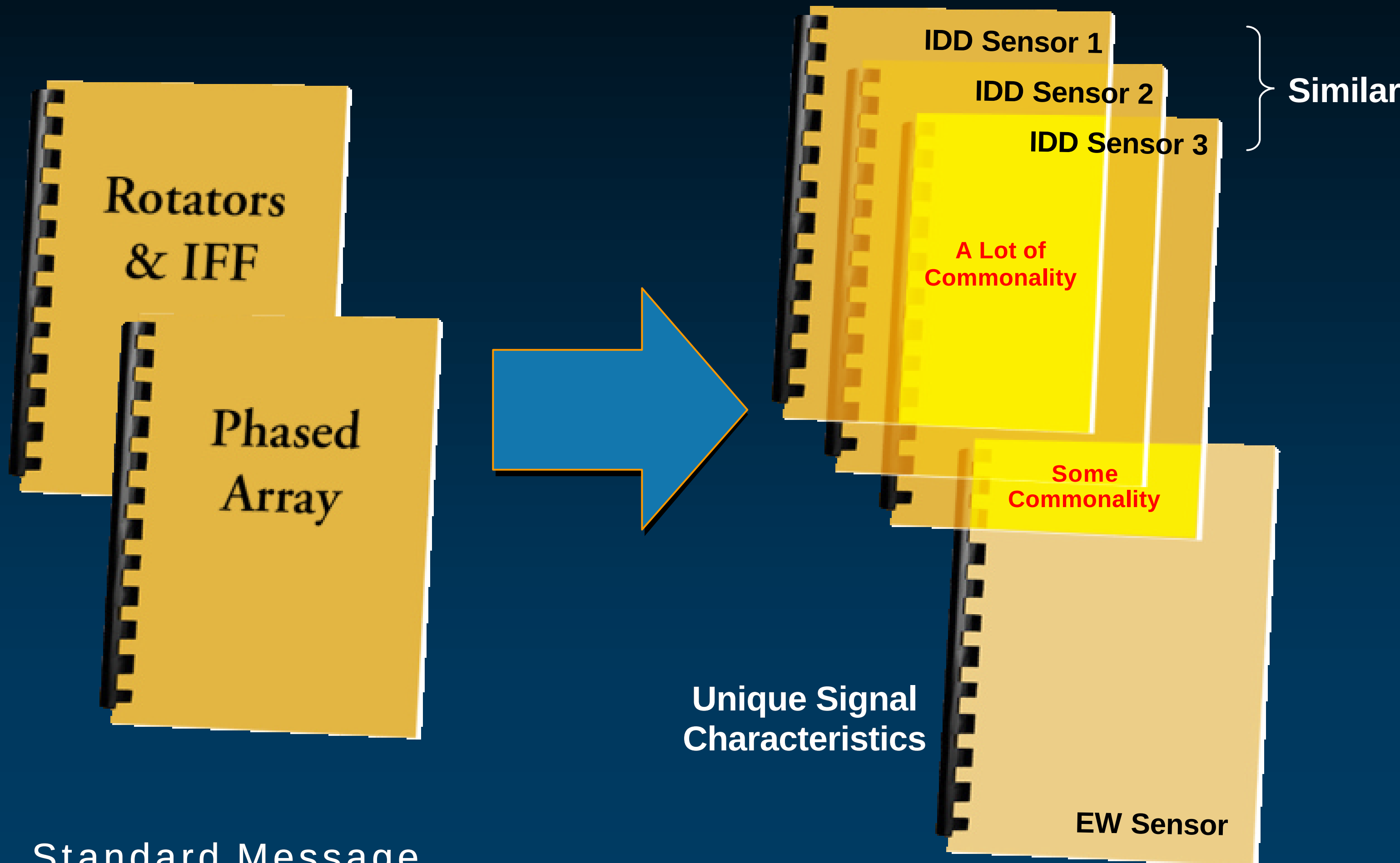
1. Registration message sent for each sensor at startup/network change
2. CEP Kernel keeps a record of registration messages from all sensors in network
3. As targets detected, CEP Kernel uses sensor messages to interpret sensor data

Demonstrated Sensor Invariance Usage





Standard Message Definition Ease IDD Development

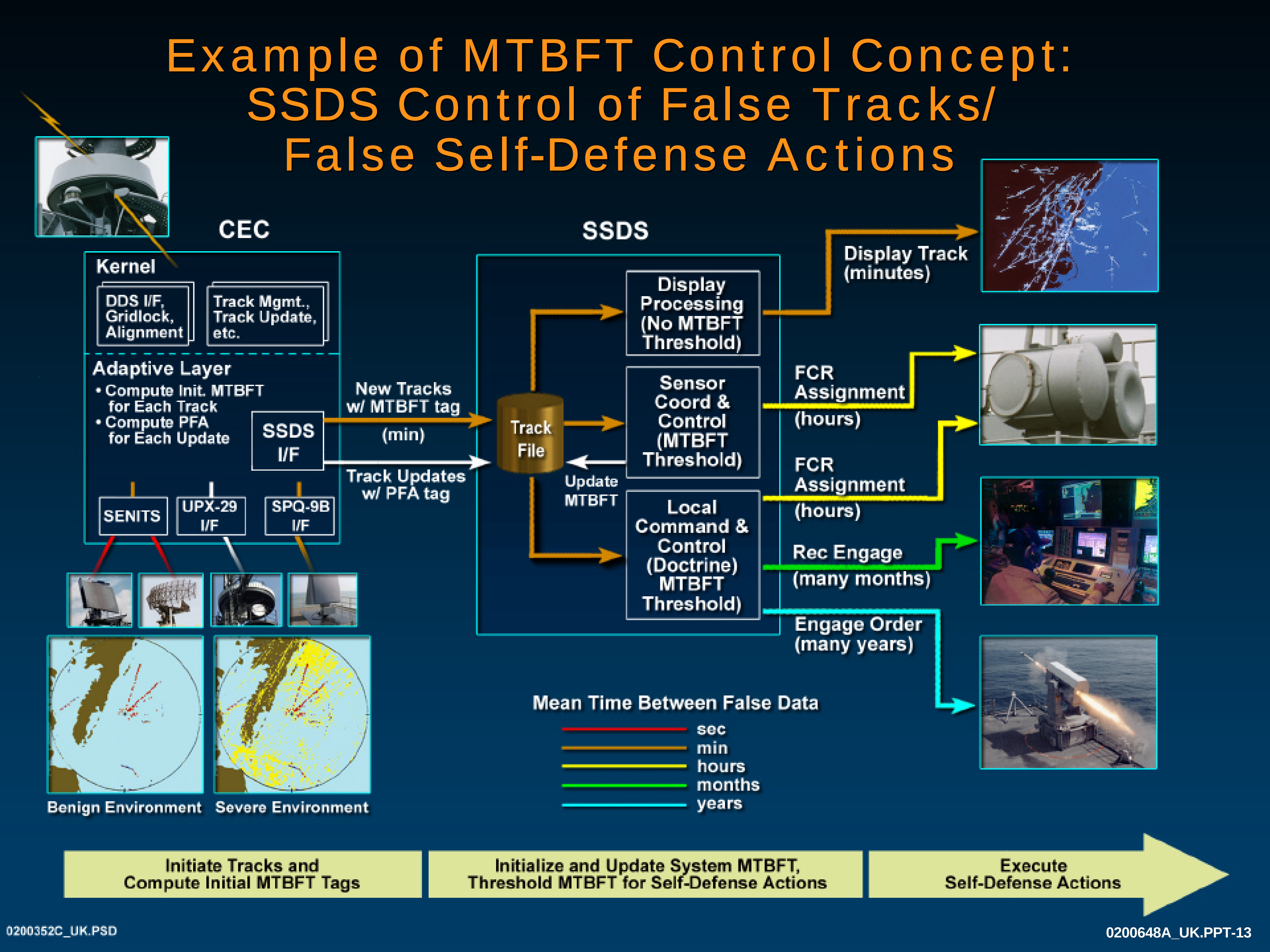


Standard Message Definition Documents for Classes of Sensors

Interface Definition Documents

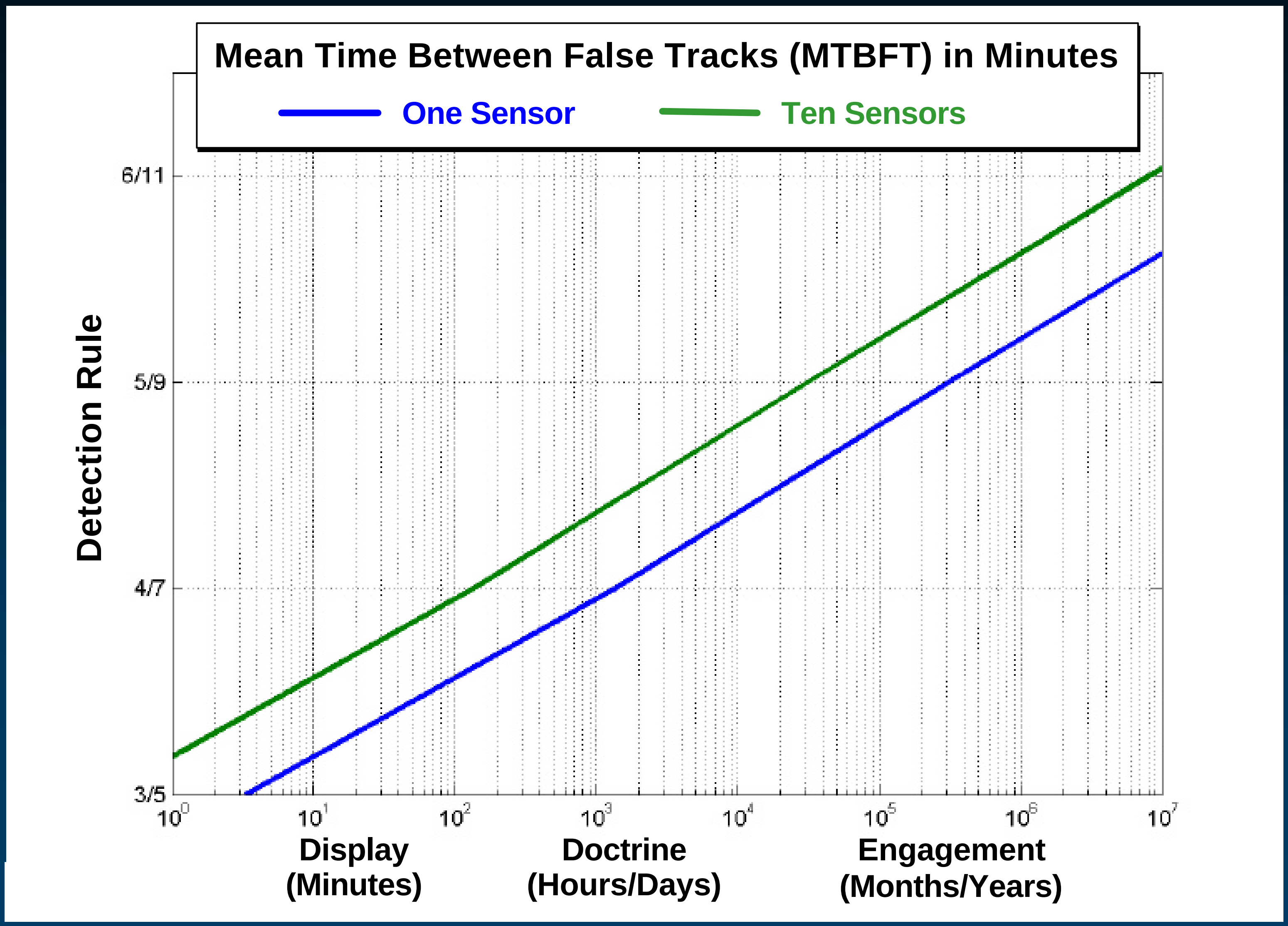
Standard Functional Requirements

- False Detection Control
  - Disclosure
  - Mean Time Between False Track (MTBFT)
- Measurement to Track Association
  - Provide measurements associated to composite track
  - Support track continuity on maneuvering target
  - Report each measurement as being associated to a single composite track
  - Probability of false association
  - Acceptance of composite track database on event driven basis
  - Maintain separate tracks on targets when sensor is resolving
- Sensor Invariant Formatting
  - Sensor's reference frame
  - Provide IFF mode or other sensor derived attributes
  - Provide measurement accuracy
- Support Functions
  - Time Synchronization
  - Test Points for test target injection
  - Time Tag
  - Support Cueing
  - Support Requests for Tracking Support
    - Gridlock, track continuity, engagement
  - Composite IFF support
    - Interrogation sectors, mode 4 interrogation policy, demand interrogations



Example of MTBFT Control Concept:
SSDS Control of False Tracks/
False Self-Defense Actions
CEC
Kernel
DDS I/F, Gridlock, Alignment
Track Mgmt., Track Update, etc.
Adaptive Layer
• Compute Init. MTBFT for Each Track
• Compute PFA for Each Update
SSDS I/F
SENITS
UPX-29 I/F
SPQ-9B I/F
Benign Environment
Severe Environment
New Tracks w/ MTBFT tag
(min)
Track Updates w/ PFA tag
SSDS
Track File
Update MTBFT
Display Processing (No MTBFT Threshold)
Sensor Coord & Control (MTBFT Threshold)
Local Command & Control (Doctrine) MTBFT Threshold)
Display Track (minutes)
FCR Assignment (hours)
FCR Assignment (hours)
Rec Engage (many months)
Engage Order (many years)
Mean Time Between False Data
sec
min
hours
months
years
Initiate Tracks and Compute Initial MTBFT Tags
Initialize and Update System MTBFT, Threshold MTBFT for Self-Defense Actions
Execute Self-Defense Actions
0200352C_UK.PSD
0200648A_UK.PPT-13

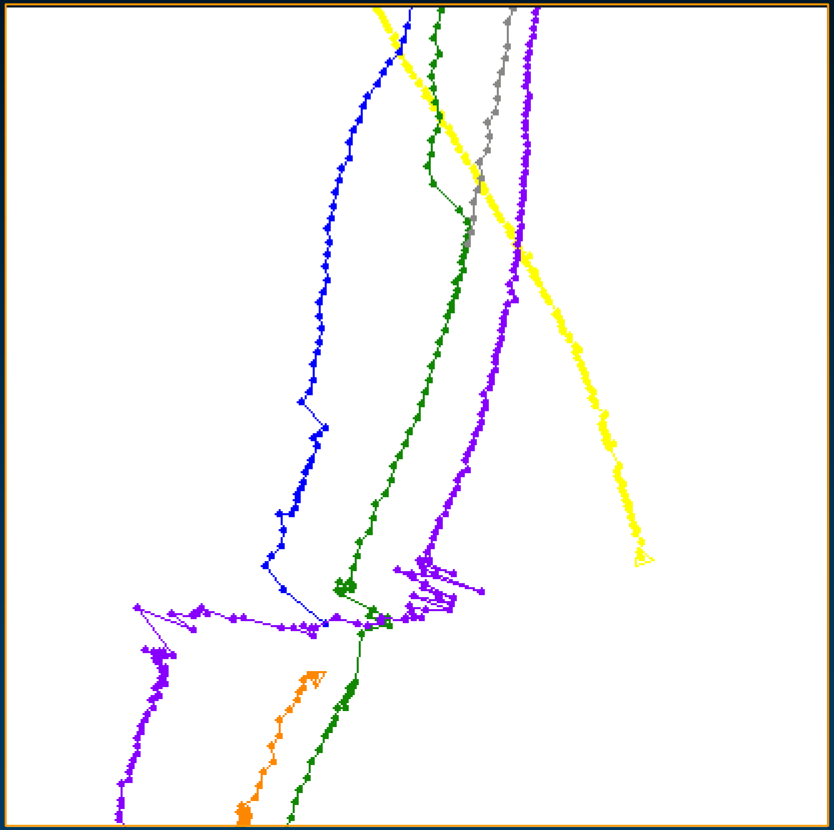
Rotating Sensor False Track Disclosure Single Sensor and Netted Sensor Environments



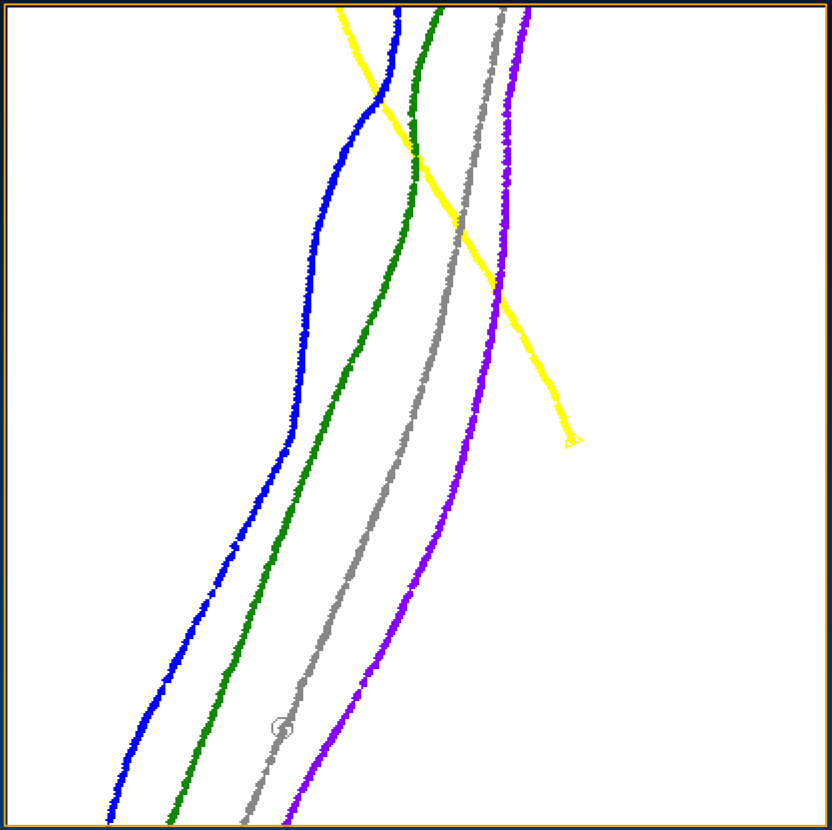
Measurement Association

- Measurement to Track (composite or local) is a key performance driver for sensor netting
  - Misassociations can cause noisy composite tracks, dual composite tracks, false composite tracks
  - Missed associations can cause loss of composite track or composite track discontinuities

Measurement Association
Example

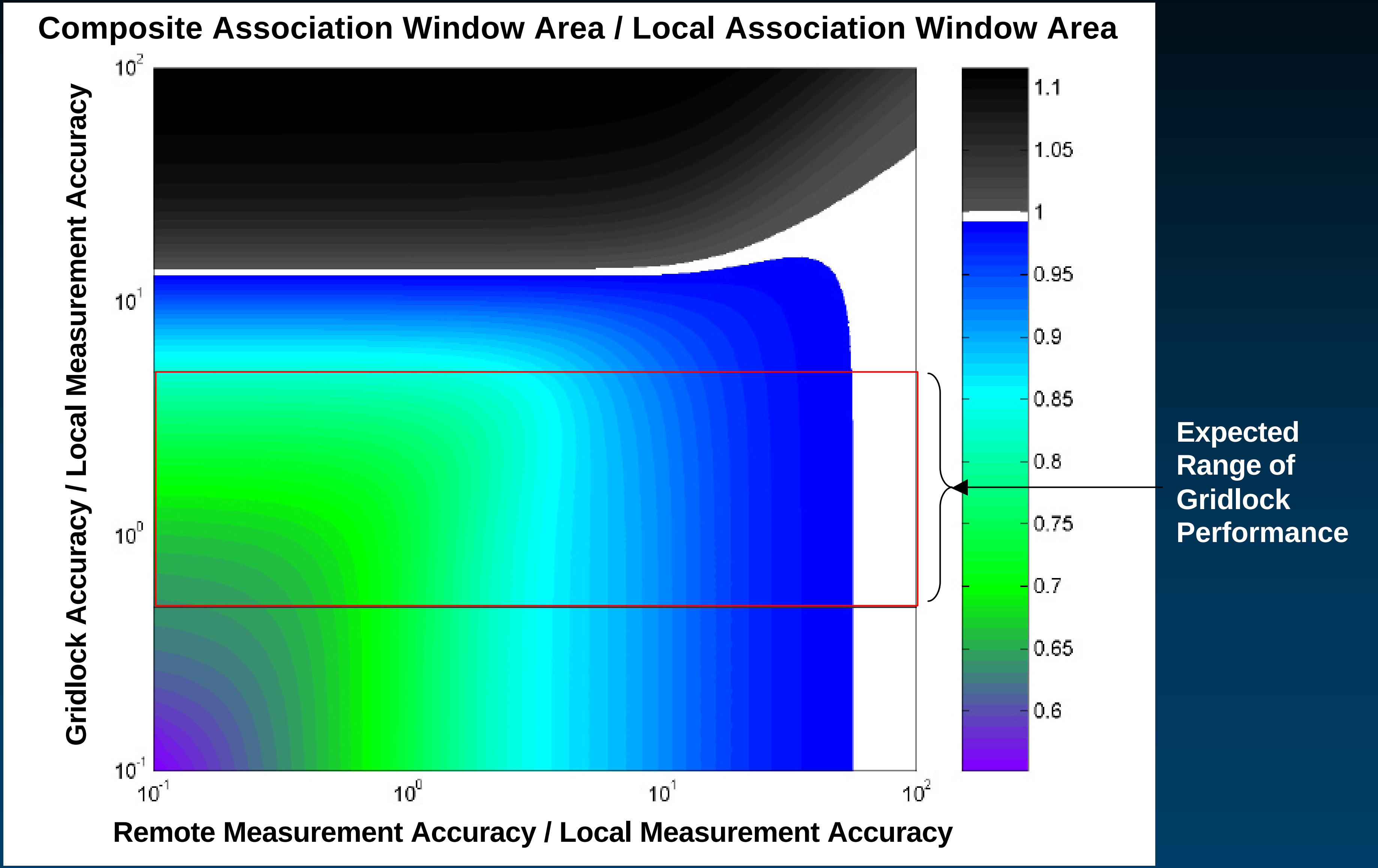


Example of
Association to Local Track

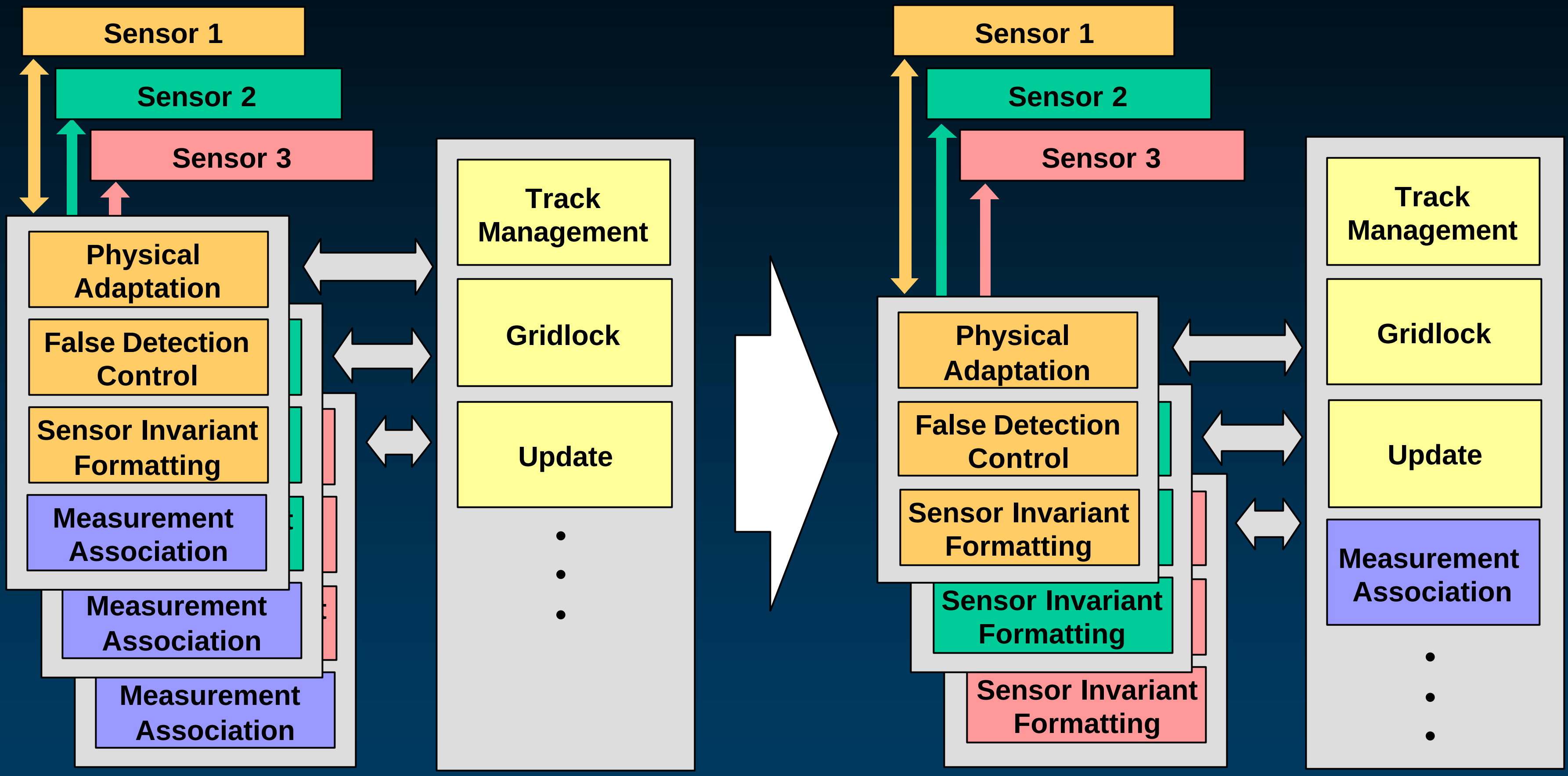


Example of
Association to Composite Track

Association to Local vs. Composite



Measurement Association – Core Function?



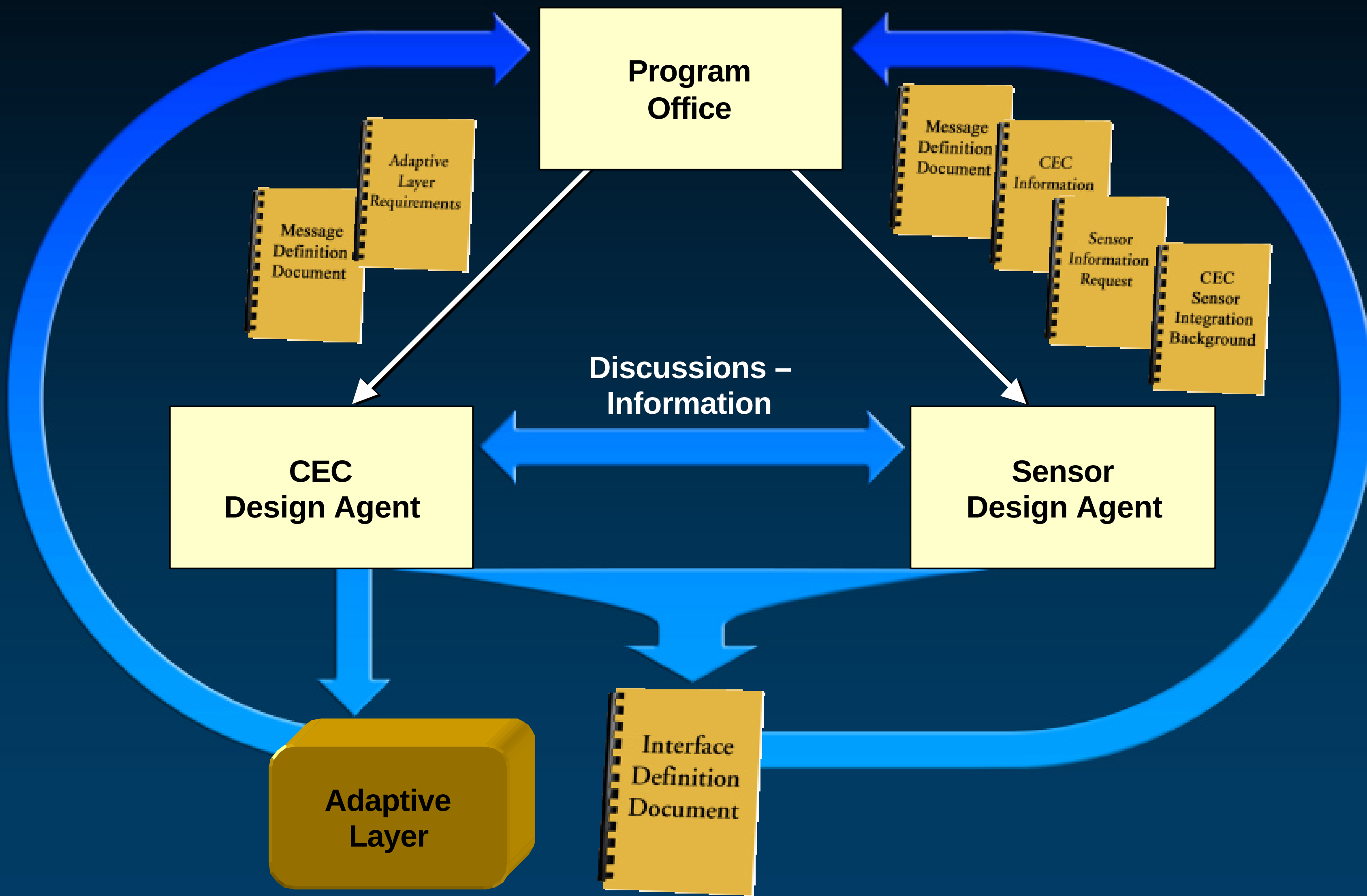
Sensor Adaptive Layers

Common Core Functions

Smaller Adaptive Layers

Common Core Functions

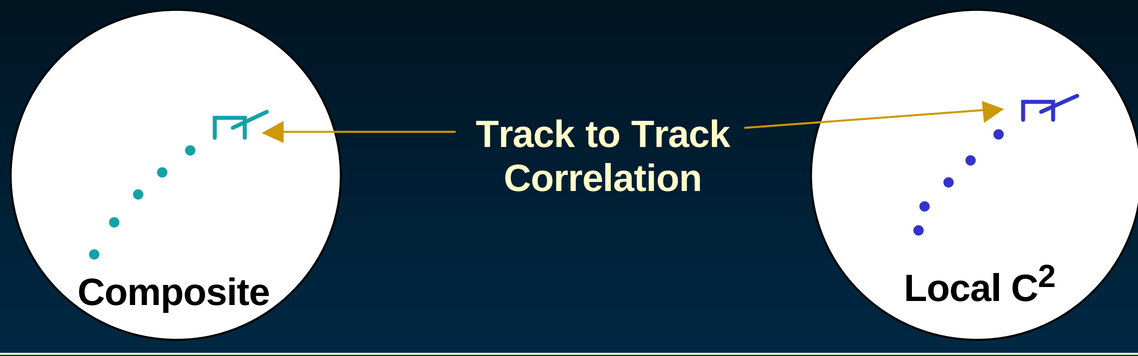
New Process for Adaptive Layer Development



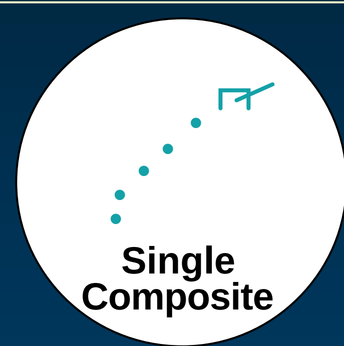
Command and Control System Adaptive Layers

The Challenge:

AEGIS



SSDS



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